

Remarks/Arguments

Claims 1 to 10, 17, 20 and 27 to 29 are pending in this patent application.

The Action includes rejections under 35 U.S.C. § 103(a). In view of the remarks below, reconsideration and withdrawal of the rejections are requested respectfully.

Discussion of the Rejections Under 35 U.S.C. § 103(a)

Claims 1, 3, 5, 6, 8, 17, and 20 have been rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over U.S. patent application Publication No. 2003/0079757 to Shibata et al. ("Shibata"). Applicants respectfully traverse this rejection, because Shibata is incapable of rendering obvious Applicants' claimed invention.

"A critical step in analyzing the patentability of claims pursuant to section 103(a) is casting the mind back to the time of invention, to consider the thinking of one of ordinary skill in the art, guided only by the prior art references and the then-accepted wisdom in the field." *In re Kotzab*, 55 U.S.P.Q.2d 1313, 1316 (Fed. Cir. 2000). "The invention must be viewed not with the blueprint drawn by the inventor, but in the state of the art that existed at the time." *In re Dembiczak*, 50 U.S.P.Q.2d 1614, 1617 (Fed. Cir. 1999) (quoting *Interconnect Planning Corp. v. Feil*, 227 U.S.P.Q. 543, 547 (Fed. Cir. 1985)). To establish a *prima facie* case of obviousness, "the examiner must show reasons that the skilled artisan, confronted with the same problem as the inventor and with no knowledge of the claimed invention, would select the elements from the cited prior art references for combination in the manner claimed." *In re Rouffet*, 47 U.S.P.Q.2d 1453, 1458 (Fed. Cir. 1998).

Applicants' Claimed Invention

Applicants' claimed invention defines a mixture for etching a dielectric material in a layered substrate, the mixture comprising: (1) a fluorocarbon; **and** (2) a fluorine-containing oxidizer selected from the group consisting of: fluoroxytrifluoromethane, bis-trifluoromethyl-trioxide, fluoro-trifluoromethyl-trioxide, fluoroformyl trifluoromethyl-trioxide, and combinations

thereof, wherein the mixture has a ratio by volume of the fluorine-containing oxidizer to the fluorocarbon of from 0.1:1 to 20:1. Shibata is incapable of providing the requisite art-suggested motivation to modify its teachings in such a way that would produce a mixture for etching a dielectric material in a layered substrate, wherein the mixture comprising: (1) a fluorocarbon; **and** (2) a fluorine-containing oxidizer selected from the recited group.

Shibata

Shibata discloses a cleaning method for a CVD apparatus wherein by-products such as SiO_2 and Si_3N_4 adhered to and deposited on surfaces of the inner wall (and internal parts) are removed by exposing the inner wall to **a fluorinated cleaning gas containing a fluorocompound**, converting the cleaning gas to plasma by means of a remote plasma generator, and introducing the plasma into the reaction chamber so that any by-products adhered to the walls and inner parts of the reaction chamber is removed.

Regarding the composition of the fluorinated cleaning gas, Shibata includes two very broad statements. First, at paragraph [0052], Shibata states that “[i]n the present invention, furthermore, it is preferred that the fluorocompound is **at least one** member selected from the group consisting of nitrogenous fluorocompounds, **oxygen-containing perfluorocarbons** and **perfluorocarbons having 1 to 6 carbon atoms**. Still preferably, the fluorocompound is a perfluorocarbon having 1 to 6 carbon atoms” (emphasis added).

Next, at paragraphs [0078] to [0087], Shibata broadly discloses:

As the fluorinated cleaning gas containing a fluorocompound to be converted to plasma by means of the remote plasma generator 30, for example, perfluorocarbons having 1 to 6 carbon atoms including:

chain aliphatic perfluorocarbons such as CF_4 , C_2F_6 , C_3F_8 , C_4F_{10} and C_5F_{12} ;

alicyclic perfluorocarbons such as C_4F_8 , C_5F_{10} and C_6F_{12} ;
linear perfluoroethers such as CF_3OCF_3 , $\text{CF}_3\text{OC}_2\text{F}_5$ and $\text{C}_2\text{F}_5\text{OC}_2\text{F}_5$;

cyclic perfluoroethers such as C_3F_6O , C_4F_8O and $C_5F_{10}O$;
unsaturated perfluorocarbons such as C_3F_6 , C_4F_8 and C_5F_{10} ;
and

diene perfluorocarbons such as C_4F_6 and C_5F_8 can be used.
Further, as the fluorinated cleaning gas, oxygen-containing
perfluorocarbons such as COF_2 , CF_3COF and **CF_3OF** ;
nitrogenous fluorocompounds such as FNO , F_3NO and FNO_2 ;
and, preferably, oxygen-containing nitrogenous
fluorocompounds can be used.

These fluorocompounds may be those having at least one
fluorine atom which result from partial replacement of the
fluorine atoms by hydrogen atoms. In particular, the use of CF_4 ,
 C_2F_6 or C_3F_8 is preferred. The use of CF_4 or C_2F_6 is still
preferred.

The above fluorocompounds ***can be used individually or in
combination*** (emphasis added).

Despite such teachings, the working examples provided by Shibata only disclose
cleaning compositions comprising a perfluorocarbon and oxygen (O_2).

The Differences Between Shibata and the Claimed Invention

Although Shibata broadly discloses a laundry list of potential components as the
fluorocompound in its fluorinated cleaning gas, Shibata does not disclose Applicants'
specific mixture comprising: (1) a fluorocarbon; ***and*** (2) a fluorine-containing oxidizer
selected from the group consisting of: fluoroxytrifluoromethane, bis-trifluoromethyl-trioxide,
fluoro-trifluoromethyl-trioxide, fluoroformyl trifluoromethyl-trioxide, and combinations thereof.
Shibata also does not recognize the surprising benefits of Applicants' claimed mixture.

No Motivation to Modify Shibata

Shibata – as a whole – is incapable of providing the requisite art-suggested
motivation to modify its teachings in such a way that would produce Applicants' claimed
invention.

It is only with the improper use of hindsight and with the benefit of the Applicants'
disclosure that one can discern the desirability of their claimed invention from that disclosed

by Shibata. For example, although Shibata uses language such as “**at least one** ...” and “the above fluorocompounds **can be used individually or in combination**”, Shibata does not lead the ordinarily skilled artisan to Applicants’ claimed mixture and the Action has provided no evidence or technical reasoning as to why such artisan would have selected Applicants’ claimed components from the many disclosed by Shibata.

Although it would have been theoretically **possible** to modify Shibata’s disclosure in a way that would have produced Applicants’ claimed invention, much more is required of a reference that is applied in the context of 35 U.S.C. § 103. The mere **possibility** that the prior art can be modified or improved does not itself provide the requisite motivation to do so. *In re Dien*, 152 U.S.P.Q. 550 (C.C.P.A. 1967) (incentive to seek improvement of existing process held to not render change made by applicant obvious, even where the change was one capable of being made from theoretical point of view). The mere possibility for modification and improvement is not the “motivating force” that the Board and the Federal Circuit have invariably required. If it were, then no modification would ever lack motivation since **some** change is always possible. It is only with the improper use of hindsight and with the benefit of the Applicant’s disclosure that one can discern the desirability of their claimed inventions.

Applicants’ Claimed Invention/ Exhibits Surprisingly Superior Results Over Shibata’s Compositions

Shibata’s working examples demonstrate the etching performance of compositions comprising a perfluorocarbon and oxygen (O₂) as the oxygen source. Applicants’ specification provides ample evidence that the claimed mixtures exhibit **surprisingly superior results** over those exemplified by Shibata.

In this regard, Shibata demonstrates the etching performance of compositions comprising either CF₄ or C₂F₆ in the presence of O₂ and argon. Applicants’ claimed invention, in contrast, employs a mixture comprising (1) a fluorocarbon **and** (2) a fluorine-

containing oxidizer selected from the group consisting of: fluoroxytrifluoromethane, bis-trifluoromethyl-trioxide, fluoro-trifluoromethyl-trioxide, fluoroformyl trifluoromethyl-trioxide, and combinations thereof. Applicants' working examples are replete with evidence that mixtures of, for example, fluoroxytrifluoromethane ("FTM", a fluorine-containing oxidizer) and a C_4F_6 (a perfluorocarbon) far out-perform a composition such as that disclosed by Shibata comprising either CF_4 or C_2F_6 in the presence of O_2 and argon. To summarize:

- Applicants' Comparative Example 2 demonstrates that FTM/ C_4F_6 chemistry offers both higher SiO_2 etch rate and higher SiO_2 /photoresist etch selectivity under otherwise identical RF power, pressure, total flow rate, and C_4F_6 concentration. For example, at similar photoresist etch rate of about 20 nm/min, FTM/ C_4F_6 chemistry showed about 50% higher SiO_2 etch rate, and about 40% higher SiO_2 /photoresist etch selectivity.
- Applicants' Comparative Example 3 demonstrates that without C_4F_6 , diluted FTM showed much higher etch rate for photoresist than that of SiO_2 , resulting the etch selectivity of SiO_2 /photoresist of only about 0.5. In fact, the etch rate of FTM without C_4F_6 is almost ten times of the etch rate of FTM with C_4F_6 . Such high etch rate of photoresist will result in complete loss of the mask resist layer before the completion of etching the underlying dielectric layer, hence loss of critical dimension for anisotropic features. Comparing to example 1, this demonstrates that, without fluorocarbons such as C_4F_6 , FTM by itself or diluted with an inert gas does not yield acceptable selective anisotropic etch performance.
- Applicants' Example 5 demonstrates that O_2 / C_4F_6 patterned wafer etch showed lower SiO_2 etch rate and lower SiO_2 /photoresist selectivity than FTM/ C_4F_6 chemistry.

Such results are indeed surprising in view of the Shibata disclosure; and no evidence has been presented that would indicate that one of ordinary skill in the art would have expected

such improved results in view of Shibata's disclosure. Accordingly, Applicants submit respectfully that the present invention is patentable over Shibata.

Claim 4 has been rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Shibata in view of U.S. Patent No. 5,176,790 to Arleo et al. ("Arleo"). Applicants respectfully traverse this rejection.

Rejected Claim 4 is dependent from independent Claim 1. Since, as discussed above, Shibata does not teach or suggest the base invention, even if Arleo discloses the additional limitations of Applicants' dependent Claim 4 (*arguendo*), its combination with Shibata still would not render obvious the claimed invention. Accordingly, reconsideration and withdrawal of the rejection is respectfully requested.

Claim 7 has been rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Shibata in view of U.S. Patent No. 6,403,491 to Liu et al. ("Liu"). Applicants respectfully traverse this rejection.

Rejected Claim 7 is dependent from independent Claim 1. Since, as discussed above, Shibata does not teach or suggest the base invention, even if Liu discloses the additional limitations of Applicants' dependent Claim 7 (*arguendo*), its combination with Shibata still would not render obvious the claimed invention. Accordingly, reconsideration and withdrawal of the rejection is respectfully requested.

Claims 9 and 10 have been rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Shibata in view of U.S. Patent No. 6,242,359 to Misra et al. ("Misra"). Applicants respectfully traverse this rejection.

Rejected Claims 9 and 10 are dependent from independent Claim 1. Since, as discussed above, Shibata does not teach or suggest the base invention, even if Misra discloses the additional limitations of Applicants' dependent Claims 9 and 10 (*arguendo*), its

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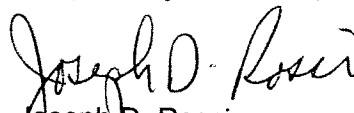
combination with Shibata still would not render obvious the claimed invention. Accordingly, reconsideration and withdrawal of the rejection is respectfully requested.

Conclusion

Applicants believe that the foregoing constitutes a complete and full response to the Action of record. Applicants respectfully submit that this application is now in condition for allowance. Accordingly, an indication of allowability and an early Notice of Allowance are respectfully requested.

The Commissioner is hereby authorized to charge the fee required and any additional fees that may be needed to Deposit Account No. 01-0493 in the name of Air Products and Chemicals, Inc.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Joseph D. Rossi". The signature is fluid and cursive, with the first name "Joseph" and last name "Rossi" clearly distinguishable.

Joseph D. Rossi
Registration No. 47,038
7201 Hamilton Boulevard
Allentown, PA 18195-1501
(610) 481-8169